SP79-MSFC-2391

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Final Report

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY PRELIMINARY REQUIREMENTS FOR SPACE SCIENCE AND APPLICATIONS PLATFORM STUDIES

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TELEDYNE BROWN ENGINEERING

Cummings Research Park• Huntsville, Alabama 35807

FINAL REPORT
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OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY PRELIMINARY REQUIREMENTS FOR SPACE SCIENCE AND APPLICATIONS PLATFORM STUDIES

NOVEMBER 1979

PREPARED FOR

INTEGRATED PAYLOAD AND MISSION PLANNING OFFICE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER

CONTRACT NO. NAS8-32711

PREPARED BY

SPACE SYSTEMS DEPARTMENT
SPACE PROGRAMS DIVISION
TELEDYNE BROWN ENGINEERING
HUNTSVILLE, ALABAMA

FOREWORD

This final report presents platform payload data that establish OAST-type mission requirements and is the result of work performed by Teledyne Brown Engineering Company under Contract NAS8-32711 for the Marshall Space Flight Center's Integrated Payload and Mission Planning Office. It is intended for use in the Space Science and Applications Platform Studies. The direct contributions of payload contacts and Mr. Von L. Burton are acknowledged.

P. K. Wunsch

P. K. Wunsch
Task Leader

C E Kaylor

C. E. Kaylor
Project Manager

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I. INTRODUCTION

Needs and requirements for a free-flying Space Science and Applications Platform to host groupings of compatible, extended-mission experiments in earth orbit are currently under development within NASA. To support the contribution of the Office of Aeronautics and Space Technology (OAST) to the larger effort a payload model has been compiled which serves to define a typical set of OAST mission requirements. That payload model in the form of a descriptive data base is presented in this document along with experiment-level and group-level data summarizations and flight schedules arranged for convenient use by both NASA managemeent and mission planning personnel.

Payloads included in the payload model were selected from a group originally identified at NASA field centers as typical of those which might be flown in a mid-1980's time frame and which would benefit from long duration flight. A joint data collection activity was undertaken by TBE and the office managing this contract in which information on the identified payloads was solicited from field center personnel. Data on some payloads were collected via telephone conversations with either the designated contact or a knowledgeable colleague, while data on other payloads were received in written form. The quantity and quality of data supplied varied widely with the level of definition of the subject payload concept. For payloads in early stages of definition, responses on a "best guess" basis were encouraged where better information was not available.

Upon completion of the initial solicitation, the data base was published in an interim report, PI79-MSFC-2325, of the same title as this document. The data file on each payload has subsequently been returned to the submitting field center for review and comment. The data that appear herein have been updated to reflect the review comments.

The payload descriptions contained in this document are grouped by technology into the following categories: Communications, Materials (Long Term Effect Upon), Materials Technology Development, Power, Sensors, and Thermal Control. Summary data tables and flight schedules which reflect

these groupings follow the data sheets. An additional summarization organized by orbital requirements, i.e., pointing, space environment, and zero gravity, has been included for the benefit of mission planners.

It is envisioned that payloads will be delivered to a space platform in groups integrated to a Spacelab pallet, module, or similar carrier which would remain with the platform. A ground rule regarding the identification of candidate payloads was that their operation not require the services of a payload specialist. All payloads were therefore considered to be pallet-mountable, and to establish carrier-level requirements, all payloads in the data base were organized into flight-compatible, pallet-size combinations. Data tables and flight schedules are presented which summarize the results of this grouping effort.

It should be mentioned that while the payload list has been shaped by considerations at a number of NASA organizational levels, the inclusion of any payload in the data base carries no significance beyond the stated purpose of this document. That is, inclusion is not meant to reflect the official position of the submitting field center nor does it imply Headquarter's approval for an extended mission. Any questions or comments regarding this document should be addressed to Von L. Burton, MSFC, Code JA61, telephone (205) 453-3423.

II. STRAWMAN PAYLOAD REQUIREMENTS

This section presents descriptive data on each platform candidate payload as provided by the identified contact. The data items were stipulated by the office managing this contract. The data were organized as a matter of convenience on a two-page summary form designed and used for Spacelab payload data. The amount and depth of data required on each payload fit this form well. That this form was adopted with little modification, however, is a result of the need to meet the demanding schedule under which these materials were originally compiled.

A. Communications

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Self-Tracking Antenna Experiments
Code No. G-8
Orig. Date
Discipline
Rev. Date
Submitted by Goddard Space Flight Center
NASA Hq Approval
Contact A. Kampinsky Center GSFC Phone (301) 344-6762
Contact Center Phone

Objective

To test in orbit, on a comparative basis, the deployment, thermal response, maximum data transfer rate, and self-tracking performance of two types of dual-frequency microwave antenna subsystems.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Payload consists of two antenna subsystems each consisting of a pedestal mounted antenna (either 1.22 m diameter unfurlable, paraboloid or high aperture efficiency foldable planar antenna) and monopulse receiver. Inclusion of transmitter optional. Antennas are deployable and self-tracking. Operating frequencies are 2 GHz and 15 GHz. On-orbit operations will directly qualify these antenna systems.

Data Sources

Telecon, Abe Kampinsky.

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☐	Modify/Upgrade Existing Hardware	9
AAFE	☐	Prepare/Refurbish Existing Hardware for Flight	
Development	☒		
Existing Hardware	☒		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights			1	1									

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	~45	Payload Volume	cu m	~3
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
1.22 m Paraboloid Antenna	1	7		1.22	m dia	
Planar Atennna	1	9	1.0	0.1	1.0	
Pedestal	2	12				
Monopulse Receiver	2	3				
Wideband Trasmitter*	1	7				
*Optional						

Power

Operating Power	W	~20	Operating Power Duration	4	hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km	850	800	900
Inclination, deg	108	30	108

Target(s) Earth transmitter stations. STADAN and/or Rosman, Mojave or equal.

Pointing, Stability, and Control

Pointing Accuracy	deg	1	Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn	4	Field of View (half angle)	deg	10
Stability	arcsec				

NOTES

Sun synchronous polar orbit desired. Prefer flight on earth resources or meteorological satellite.
Transmitter would require additional 10 W of power.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym: ESSA Communication Subsystem
Code No.: G-7
Orig. Date:
Discipline: Mission Support Equipment
Rev. Date:
Submitted by: Goddard Space Flight Center
NASA Hq Approval:
Contact: R. Hockensmith Center: GSFC Phone: (301) 344-7416/6756
Contact: Center: Phone:

Objective

To perform operational testing of the Electronic Switching Spherical Array (ESSA) antenna with both a global positioning receiver processor and a standard TDRSS transponder. The system can be used with any experiment or group of experiments on either the orbiter or a free flyer with data rate up to 15 kbps.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

The antenna is slightly more than a 0.77 m dia. hemisphere. All subsystems are contained within the hemisphere. The antenna must have clear view of TDRSS during operation.

Data Sources

Telecon with R. Hockensmith.

Development Status

Status			Time (mos.)
Planning	[ ]	New Development	10
Definition Studies	[x]	Modify/Upgrade Existing Hardware	
AAFE	[ ]	Prepare/Refurbish Existing Hardware for Flight	
Development	[ ]		
Existing Hardware	[ ]		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights		x											

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	~100	Payload Volume	cu m	0.13
Landed Weight	kg	~100	Pressurized Equipment	cu m	0
Pressurized Equipment	kg	0	Unpressurized Equipment	cu m	0.13
Unpressurized Equipment	kg	~100	Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Antenna and Transponder	1	~100	0.77	0.77	0.4	Pallet or
and GPS Rec/Processor						Free Flyer

Power

Operating Power	W	37/33*	Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

		Operational Orbit		
		Desired	Minimum	Maximum
Altitude,	km	Not critical		
Inclination,	deg	Not critical		

Target(s) TDRSS must be within viewing hemisphere.

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Suitable for use as communications subsystem for any group of experiments, shuttle attached or free flyer. Data rate capability through TDRSS up to 15 kbps.
TDRSS must be in view during operation.
Needs at least one shuttle flight for qualification before use on long term free flyer. Can be used as communications subsystem during test flights.
*GPS Receiver/Processor draws 37 W, Antenna and Transponder draws 33 W.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Fiber Optic Multiplexer for Inter-Computer Communication

Code No. JSC-1

Orig. Date

Discipline

Rev. Date

Submitted by Johnson Space Center

NASA Hq Approval

Contact E. Dalke Center JSC Phone (713) 483-2851

Contact R. Kennedy Center JSC Phone (713) 483-4281

Objective

To measure the transient effects of high energy space particles on monolithic integrated fiber optics and off-shelf microprocessor components technology for digital processing and communication systems.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Self contained experiment package consisting of two microcomputers communicating memory to memory over fiber optic link. Link is a single strand for half duplex transmission of a parallel 16 data bit format. TX/RX terminal utilizes integrated optical mux/demux developed under Advanced Information Management RTOP 906-33-11. Microcomputer to employ various memory technologies configured to allow assessment of particle penetrations. Software will register bit errors and transient upsets. Only external interface required is for on-orbit initialization.

Data Sources

JSC

Development Status

Status		Type	Time (mos.)
Planning	[x]	New Development	
Definition Studies	[ ]	Modify/Upgrade Existing Hardware	
AAFE	[ ]		
Development	[ ]	Prepare/Refurbish Existing Hardware for Flight	
Existing Hardware	[ ]		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights													

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	25	Payload Volume	cu m	0.025
Landed Weight	kg	25	Pressurized Equipment	cu m	-
Pressurized Equipment	kg	-	Unpressurized Equipment	cu m	-
Unpressurized Equipment	kg	-	Control & Display Area	sq m	-

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location

Power

Operating Power	W	100	Operating Power Duration	84	hr
Peak Power	W	100	Peak Power Duration	84	hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	*		
Inclination, deg			

Target(s) ________________

Pointing, Stability, and Control NA

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

*Recommended altitude will be identified during early development phase.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Large Deployable Antenna With Electronic Beam Steering
Code No. J-11
Orig. Date
Discipline
Rev. Date
Submitted by: Jet Propulsion Laboratory
NASA Hq Approval
Contact: K. Woo Center: JPL Phone: (213) 354-3433
Contact: R. Freeland Center: JPL Phone: (213) 354-3548

Objective

The objectives are to: (1) develop large, low cost, reusable antenna technology, (2) demonstrate mechanical and RF performance in the space environment, (3) evaluate electronic beam steering capability in space in a dynamic vehicle environment, (4) validate large deployable antenna performance prediction models, and (5) enable a number of future missions.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

The main reflector, its support structure, and the subreflector support are mounted to the pallet in furled configuration along with the feed, electronics, and surface evaluation equipment. Remote control from the cabin area is used to extend the reflectors on their telescoped support trusses and to unfurl the main reflector. Operation of the optical surface evaluation and RF equipment is controlled by the experiment-dedicated orbiter computer which is updated by commands from the ground. Data retrieval is primarily via transmission to ground, however, some tape storage capability has been assumed.

Data Sources

Development Status

Time (mos.)

- Planning [x]
- Definition Studies [ ]
- AAFE [ ]
- Development [ ]
- Existing Hardware [ ]

Modify/Upgrade Existing Hardware ______

Prepare/Refurbish Existing Hardware for Flight ______

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights							1						

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	1179	Payload Volume	cu m	18.9*
Landed Weight	kg	1179	Pressurized Equipment	cu m	1.3
Pressurized Equipment	kg	109	Unpressurized Equipment	cu m	18.9
Unpressurized Equipment	kg	1070	Control & Display Area	sq m	1.0

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Antenna Reflector	1	680	3.4*	3.4*	1.0*	On top of support
Support to Pallet Structure	1	140	2.2	2.2	1.7	Centered on two joined pallets
Surface Evaluation Equipment	1	109	1.0	1.0	1.3	
RF Feeds, Ref. Antenna and						
Electronics	1	70	1.1	0.5	0.7	
Equipment Platform and						
Extension Structure	1	180	1.1	1.1	1.0	Centered on top of reflector
*In stowed configuration.						

Power

Operating Power	W	200/60	Operating Power Duration	200 W for 20 60 W for 80	hr
Peak Power	W	395	Peak Power Duration	5	hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km	Any		
Inclination, deg	Any		

Target(s) ______

Pointing, Stability, and Control

Pointing Accuracy	deg	0.1	Stability Rate	arcsec/sec	90
Total Pointing Time	hr/msn	100	Field of View (half angle)	deg	20
Stability	arcsec	40			

NOTES

Flight duration--1 mo - 1 yr.

B. Materials (Long Term Effect Upon)

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Long-Term Space Environmental Effects on Materials
Code No. M-2
Orig. Date
Discipline
Rev. Date
Submitted by
NASA Hq Approval
Contact Dr. R. L. Gause Center MSFC Phone (205) 453-1500
Contact Center Phone

Objective

To evaluate the long-term effects of the space environment on candidate materials for future long duration space programs.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Conduct tests on samples (metallic/nonmetallic) primarily of a thermal cycling nature. Metallic samples on order of 0.005 in. thick (used in beam maker). Optical properties degradation determination is also important.

Data Sources

Ann Whitaker (EH14), (205) 453-4877.

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☐	Mod' y/Upgrade Existing Hardware	
AAFE	☐		
Development	☐	Prepare/Refurbish Existing Hardware for Flight	
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights													

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	~70	Payload Volume	cu m	1
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Samples and instrumentation		~70	1	1	1	

Power

Operating Power	W	100	Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

		Operational Orbit		
		Desired	Minimum	Maximum
Altitude,	km	*		
Inclination,	deg			

Target(s) Expose test samples uniformly to sun.

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--1 to 2 years. Flight schedule should be early enough to provide data that can be used in development of large space structures.
No flight hardware currently available.
Will need to monitor UV exposure level.
*Same altitude that large space structures will be flying.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Long Term Radiation Exposure of Materials
Code No. La-1
Orig. Date
Discipline
Rev. Date
Submitted by Langley Research Center
NASA Hq Approval
Contact Wayne Slemp Center LaRC Phone (804) 827-3041
Contact Center Phone

Objective

Evaluate the effects of long-term space radiation exposure on advanced spacecraft materials including: composites, adhesives, sealants, thermal control coatings, and polymeric films.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Specific package geometry/configuration TBD. Ten units will provide space for instrumentation and data management. A typical configuration concept is illustrated by LDEF-type trays. On-going research is providing data for final designs. Materials selection, sample sizes, and orbit selections (including needs for propulsive free-flyer, etc.) will determine final configuration. Shuttle revisits (in 2-3 years after launch) are visualized to retrieve initial samples and add new ones as required by advances in research results.

Data Sources

Development Status

Time (mos.)

- Planning [x]
- Definition Studies [ ]
- AAFE [ ]
- Development [ ]
- Existing Hardware [ ]

Modify/Upgrade Existing Hardware ________

Prepare/Refurbish Existing Hardware for Flight ________

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights					1								

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg 560	Payload Volume	cu m 2.8
Landed Weight	kg 560	Pressurized Equipment	cu m 0
Pressurized Equipment	kg 0	Unpressurized Equipment	cu m 2.8
Unpressurized Equipment	kg 560	Control & Display Area	sq m 0

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
LDEF Trays	10	56 ea.	1.22	0.76	0.30	
Total (10 units)		560				

Power

Operating Power	W	10	*Operating Power Duration	25	hr/yr
Peak Power	W	TBD	Peak Power Duration	TBD	hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	1000	TBD	TBD
Inclination, deg	28.5 - 57	TBD	TBD

Target(s) Space radiation of outer Van Allen Belts. (TBD)

Pointing, Stability, and Control

Pointing Accuracy deg ______
Total Pointing Time hr/msn ______
Stability arcsec ______
Stability Rate arcsec/sec ______
Field of View (half angle) deg ______

NOTES

Operating power is for telemetry, and other instrumentation including: dosemetry, reheovibron, and strain gauges.
Propulsive payload desired.
*Solar panels with pointing anticipated for power generation.

C. Materials Technology Development

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Continuous Casting of Billets and Slabs
Code No. M-7
Orig. Date
Discipline
Rev. Date
Submitted by Massachusetts Institute of Technology
NASA Hq Approval
Contact G. von Tiesenhausen Center MSFC Phone (205) 453-2789
Contact D. Smith Center MIT Phone (617) 253-2272

Objective

Measurement of the effects of cooling rate, temperature distribution, alloy composition and caster dimensions on the microstructure of aluminum and steel castings.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Equipment : Container for liquid metal received from furnace; magnetic coils for application of pressure; caster molds (~3.0 x 0.5 x 0.5 m); cooling fluid and jacket; radiator.

Operations: Set up and test cooling and pressurization systems; put furnace and caster into operation; collect billets and slabs for return to earth.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

			Time (mos.)
Planning	[ ]	Modify/Upgrade Existing Hardware	
Definition Studies	[x]	Prepare/Refurbish Existing Hardware for Flight	
AAFE	[ ]		
Development	[ ]		
Existing Hardware	[ ]		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights					3	3		2	2				

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	1
Landed Weight	kg	~200	Pressurized Equipment	cu m	-
Pressurized Equipment	kg	-	Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	-

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Furnace	1					
Molds	3-4	15	3.0	0.50	0.50	
Cooling Fluid Jacket & Pump	1	15				
Radiator	1	150	17.0	5.0	0.001	
Radiator (Folded)			2.0	5.0	0.01	

Power

Operating Power	W		Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s)

Pointing, Stability, and Control NA

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 10 days.
Orbital service interval: Could be integral part of hardware for space manufacturing development used to produce AL sections (together with a furnace). Could also be modified to handle other materials.
Radiator would have approximately 140 m^2 of area when fully extended.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Space Welding and Cutting Techniques Laboratory
Code No. M-12
Orig. Date
Discipline
Rev. Date
Submitted by Massachusetts Institute of Technology
NASA Hq Approval
Contact G. von Tiesenhausen Center MSFC Phone (205) 453-2789
Contact D. Smith Center MIT Phone (617) 253-2272

Objective

To test equipment and output quality of welds and cuts made in space on a wide variety of materials and shapes, with different thermal histories. Effect of zero-g and vacuum on different welds and cuts.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Welders: Electron beam, laser, ultrasonic, electrostatic, impact, brazing, vacuum-contact. Workpieces of Al, Cu, Fe, Mg, Tl alloys, glasses, and solar cells. After welding or cutting, pieces to be returned to earth for microstructure tests. Cuts using laser or electron beam techniques on listed workpieces should be made.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

- [ ] Planning
- [x] Definition Studies
- [ ] AAFE
- [ ] Development
- [ ] Existing Hardware

	Time (mos.)
New Development	
Modify/Upgrade Existing Hardware	
Prepare/Refurbish Existing Hardware for Flight	

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights				2	3	3							

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	1
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Power Source	1					
Electron-Beam Welder/Cutter	1					
Laser Welder/Cutter	1					
Electrostatic Welder	1					
Ultrasonic Welder	1					
Impact Welder	1					
Vacuum Contact Welder	1					
Workpieces	30					
Holding Jigs						

Power

Operating Power	W		Operating Power Duration		hr
Peak Power	kW	200 (est.)	Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ______

Pointing, Stability, and Control NA

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 10 days.
Orbital service interval: It would be useful to have the equipment available for further tests after evaluation of the initial output.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Casting of Complex Parts — Code No. M-8
Orig. Date
Discipline — Rev. Date
Submitted by: Massachusetts Institute of Technology — NASA Hq Approval
Contact: G. von Tiesenhausen — Center: MSFC — Phone: (205) 453-2789
Contact: D. Smith — Center: MIT — Phone: (617) 253-2272

Objective

Measurement of the effects of cooling rate, mold shape, pressure, and alloy composition on castings made by forcing liquid metal into evacuated molds.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Equipment: Furnace; several multiple-piece molds; pipes to convey liquid metal; cooling jacket and fluid; variable speed pump for cooling fluid; radiator.
Operations: Connect pipes to furnace and molds; set up and test cooling system; astronaut must regulate pressure and cooling rate for each casting and remove castings from mold.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Laboratory, MIT.

Development Status

- [ ] Planning
- [x] Definition Studies
- [ ] AAFE
- [ ] Development
- [ ] Existing Hardware

	Time (mos.)
New Development	
Modify/Upgrade Existing Hardware	
Prepare/Refurbish Existing Hardware for Flight	

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights							3	3	3				

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	1
Landed Weight	kg	200	Pressurized Equipment	cu m	-
Pressurized Equipment	kg	-	Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Furnace	1					
Molds	10	10	0.5	0.5	0.5	
Pipes	5	10	0.5	0.5	0.5	
Cooling Jacket, Fluid & Pump	1	15				
Radiator (folded)	1	150	2.0	5.0	0.01	

Power

Operating Power W ______ Operating Power Duration ______ hr
Peak Power W ______ Peak Power Duration ______ hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ______

Pointing, Stability, and Control

Pointing Accuracy deg ______ Stability Rate arcsec/sec ______
Total Pointing Time hr/msn ______ Field of View (half angle) deg ______
Stability arcsec ______

NOTES

Flight duration: 20 days.
Orbital service interval: Best use of this equipment is to run a batch of castings, bring output to earth for extensive tests, then run other batches to verify theories and develop casting techniques further. Equipment (together with furnace) can also produce useful space hardware.
Radiator would have approximately 140 m^2 of area when fully extended.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Rotating Furnace for Glass Production
Code No. M-9
Orig. Date
Discipline
Rev. Date
Submitted by: Massachusetts Institute of Technology
NASA Hq Approval
Contact: G. von Tiesenhausen Center: MSFC Phone: (205) 453-2789
Contact: D. Smith Center: MIT Phone: (617) 253-2272

Objective

Development and demonstration of centrifugal furnace for the melting of glass particles.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Activities include startup and shutdown, operation with varying heating rates, temperatures, particle sizes, glass composition, rotation rates. Slagging agents can be added to clean the glass. Investigation of flow pattern, temperature distributions. Payload specialist to take measurements, reset and adjust operations.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☒	Modify/Upgrade Existing Hardware	
AAFE	☐	Prepare/Refurbish Existing Hardware for Flight	
Development	☐		
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights							3	3	3				

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg 500	Payload Volume	cu m 2
Landed Weight	kg	Pressurized Equipment	cu m
Pressurized Equipment	kg	Unpressurized Equipment	cu m
Unpressurized Equipment	kg	Control & Display Area	sq m

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Rotating Furnace + Motor	1	100	1.5	1.0	1.0	
Power Source	1					
Output Pipe	1	10				
Cooling Jacket	1	20				
Cooling Pump	1	10				
Radiator	1					
Containers for Inputs	3-6					
Mixer + Input Pipe	1					

Power

Operating Power	W	Operating Power Duration	2-3 hr
Peak Power	W	Peak Power Duration	1-2 hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ______

Pointing, Stability, and Control

Pointing Accuracy	deg	Stability Rate	arcsec/sec
Total Pointing Time	hr/msn	Field of View (half angle)	deg
Stability	arcsec		

NOTES

Flight duration: 40 days.
Orbital service interval: Could be used several times, first for development, later to feed molten glass to other experiments.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Direct Vaporization of Silicon Sheet
Code No.: M-15
Orig. Date:
Discipline:
Rev. Date:
Submitted by: Massachusetts Institute of Technology
NASA Hq Approval:
Contact: G. von Tiesenhausen — Center: MSFC — Phone: (205) 453-2789
Contact: D. Smith — Center: MIT — Phone: (617) 253-2272

Objective

To test the feasibility of using an electron beam to do a direct vaporization of semiconductor-grade silicon onto a molybdenum strip. The deposition process will be accompanied by an ion-implantation of boron and phosphorous to form a p-n junction.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

The experiment will be carried out in-vacuo. The payload specialist will make many runs, varying such parameters as electron gun, power, deposition time (thickness of Si film), concentration of dopant; and initial temperature and cooling rate of molybdenum substrate. After the silicon has solidified, the payload specialist will peel away the molybdenum strip, replace it with a new one and begin a new run.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

- [ ] Planning
- [x] Definition Studies
- [ ] AAFE
- [ ] Development
- [ ] Existing Hardware

	Time (mos.)
New Development	
Modify/Upgrade Existing Hardware	
Prepare/Refurbish Existing Hardware for Flight	

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights							1	2	3				

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	______	Payload Volume	cu m	______
Landed Weight	kg	______	Pressurized Equipment	cu m	______
Pressurized Equipment	kg	______	Unpressurized Equipment	cu m	______
Unpressurized Equipment	kg	______	Control & Display Area	sq m	______

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Electron Gun	1					
Silicon Rod Feeders	2					
Ion Implantation Devices	2					
Directional Tubes	2					
Molybdenum Strip	100					
Heater Generator	1					
Cooling Pump	1					
Ceramic Plate	1					

Power

Operating Power	W	______	Operating Power Duration	______	hr
Peak Power	W	______	Peak Power Duration	______	hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ______

Pointing, Stability, and Control

Pointing Accuracy	deg	______	Stability Rate	arcsec/sec	______
Total Pointing Time	hr/msn	______	Field of View (half angle)	deg	______
Stability	arcsec	______			

NOTES

Flight duration: 20 days.
Orbital service interval: Best use of equipment is to make many runs and bring solar cells back to earth for test to study crystal structure.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Direct Vaporization of Aluminum Through Shadow Masks and Subsequent Mask Cleanup
Code No. M-17
Orig. Date
Discipline
Rev. Date
Submitted by Massachusetts Institute of Technology
NASA Hq Approval
Contact G. von Tiesenhausen Center MSFC Phone (205) 453-2789
Contact D. Smith Center MIT Phone (617) 253-2272

Objective

To test the feasibility of using an electron beam to do a direct vaporization of Al through a shadow mask onto space-grown silicon sheet, and then test a mask cleanup technique which could be eventually adapted to a continuous, automated solar cell contact producing system.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Vaporous Al, produced by electron beam, would be sprayed through a teflon mask which would be positioned above a silicon sheet. After the deposition process, the mask would be removed by a payload specialist and placed in an abrasive-brushing system. The payload specialist would vary such parameters as deposition rate and height at mask above silicon sheet.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

			Time (mos.)
Planning	[ ]	New Development	
Definition Studies	[x]	Modify/Upgrade Existing Hardware	
AAFE	[ ]	Prepare/Refurbish Existing Hardware for Flight	
Development	[ ]		
Existing Hardware	[ ]		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights							1	2	3				

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	1
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Electron Gun	1					
Continuous Feeder	2					
Al Rod	2					
Mask Positioning System	2					
Mask Cleanup System	1					

Power

Operating Power	W		Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ________

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 20 days.
Orbital service interval: Experiment could benefit from further runs after evaluation of initial output.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym	Direct Vaporization of Silica Glass Onto Space-Grown Silicon Sheets With Al Contacts	Code No.	M-18
Discipline		Orig. Date	
		Rev. Date	
Submitted by	Massachusetts Institute of Technology	NASA Hq Approval	
Contact	G. von Tiesenhausen	Center MSFC	Phone (205) 453-2789
Contact	D. Smith	Center MIT	Phone (617) 253-2272

Objective

To test the feasibility of using an electron beam to do a direct vaporization of fused silica glass onto a space-grown silicon sheet that has had Al contacts directly vaporized onto it.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

An electron gun will vaporize a continuous feed of silica glass and deposit it on a temperature controlled silicon sheet. Many runs will be made and the payload specialist will vary such parameters and electron beam intensity rate and depth of deposition and substrate temperature.

Data Sources

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☒	Modify/Upgrade Existing Hardware	
AAFE	☐	Prepare/Refurbish Existing Hardware for Flight	
Development	☐		
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights							1	2	3				

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	1
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Electron Gun	1					
Silica Glass Rod Storage	2					
Continuous Feeders	2					
Ceramic Plate	1					
Heating Coil	1					
Cooling Pump/Radiator	1					
Power Source	1					

Power

Operating Power	W		Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s)

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 20 days.
Orbital service interval: Best use of equipment is for payload specialist to do many runs; varying parameters and to return samples to earth for detailed analysis of crystal structure and effects on solar cell performance.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Glass Foaming
Code No. M-11
Orig. Date
Discipline
Rev. Date
Submitted by Massachusetts Institute of Technology
NASA Hq Approval
Contact G. von Tiesenhausen Center MSFC Phone (205) 453-2789
Contact D. Smith Center MIT Phone (617) 253-2272

Objective

Determination of physical properties of glasses foamed under zero-gravity conditions in addition to verification of foaming process, variation of foaming agents, raw materials, and thermal cycle.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Equipment: Storage for raw materials and foaming agent(s); foaming/annealing furnace; power source for furnace; (automated removal and storage of products); cooling system for furnace.
Operations: the raw materials are fed into the furnace and taken to the temperature (~1500 °F) at which the foaming agent is added. After the foaming procedure is complete, the furnace may be taken into the annealing cycle in which the product is cooled over a period of 12-14 hours. The final product may be removed by the payload specialist or automatically, the latter allowing the option of storing materials and running the production cycle several times using different foaming agents, raw materials, and thermal cycles.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☒	Modify/Upgrade Existing Hardware	
AAFE	☐		
Development	☐	Prepare/Refurbish Existing Hardware for Flight	
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights								3	4	4			

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	2
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location in Orbiter
Raw Materials Bin	1-6					
Foaming Agent	1-6					
Foaming/Annealing Furnace	1					
Furnace Power Source	1					
Furnace Cooling System	1					
Product Storage Bin	1					
Raw Material Input Feed Sys.	1					
Foaming Agent Feed System	1					

Power

Operating Power	W		Operating Power Duration	16	hr/cycle
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ______

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 70 days (perhaps longer).
Orbital service interval: occasional monitoring, removal of output, resetting of operations cycle. It would be useful to do experiment again after the evaluation of initial output.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Wire Drawing and Glass Fiber Extrusion Code No. M-13
Orig. Date
Discipline Rev. Date
Submitted by Massachusetts Institute of Technology NASA Hq Approval
Contact G. von Tiesenhausen Center MSFC Phone (205) 453-2789
Contact D. Smith Center MIT Phone (617) 253-2272

Objective

To investigate microstructure and properties of glass fibers and Al or Fe (or alloys) wire extruded/drawn in zero-g; under various thermal conditions, drawing speeds, feed pressures, and lubrication techniques.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Small package (see sketch). Extrusion/drawing of wires and fibers with different compositions, thermal conditions, lubricants, diameters, feed pressures. Human operator to monitor equipment (in case wire breaks) and to change operations. Return output to earth.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☒	Modify/Upgrade Existing Hardware	
AAFE	☐	Prepare/Refurbish Existing Hardware for Flight	
Development	☐		
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights							2	3	3				

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	0.5
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location in Orbiter
Metal Container (with heating coils)	1		0.5	0.3	0.3	
Gas Container	1					
Hydraulic Piston	1		0.3			
Lubricant Canisters	2-4					
Metal/Glass Ingots (Input)	4-6					
Power Source	1					
Lubricant Feed System	1					
Output Spools	6-8					
Output Spool Motor	1					
Dies	4-6					

Power

Operating Power	W		Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ______

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 20 days.
Orbital service interval: Occasional attention to reset operating parameters (load ingots, vary settings, thread output onto spools).

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Chemical Vapor Deposition of Silicon Sheet
Code No.: M-14
Orig. Date:
Discipline:
Rev. Date:
Submitted by: Massachusetts Institute of Technology
NASA Hq Approval:
Contact: G. von Tiesenhausen — Center: MSFC — Phone: (205) 453-2789
Contact: D. Smith — Center: MIT — Phone: (617) 253-2272

Objective

To test the feasibility of using silane gas tc do a chemical vapor deposition of semiconductor-grade silicon onto a heated molybdenum strip to form a thin film of silicon. The deposition process will be accompanied by an ion-implantation of boron and phosphorous to form a p-n junction.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

A canister of silane gas will be brought from Earth. The gas will be deposited on a molybdenum substrate heated to 1070 °K. The dissociated hydrogen will be removed so as not to inhibit the deposition process. The moly strip will then be cooled by ceramic plate. A payload specialist will vary parameters as deposition rate, concentration of dopants and cooling. The specialist will also vary the silane exhaust pressure. After the substrate is cooled, the moly strip is peeled away, and a new one is replaced and a new run is started.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☒	Modify/Upgrade Existing Hardware	
AAFE	☐		
Development	☐	Prepare/Refurbish Existing Hardware for Flight	
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights								2	3	4			

Code No. M-14

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	1
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location in Orbiter
Mixing Chamber/Sprayer	1					
Silane Gas Pump	1					
Hydrogen Removal Pump	1					
Ion Implantation Devices	2					
Directional Tubes	2					
Ceramic Plate	1					
Heating Coil	1					
Cooling Pump	1					
Radiator	1					

Power

Operating Power W ______ Operating Power Duration ______ hr

Peak Power W ______ Peak Power Duration ______ hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ______

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 20 days.

Orbital service interval: Best use of equipment is to do many runs and return samples to earth for study of crystal formation. However, it is also highly advantageous to be able to test the solar cells after each batch produced, so that production equipment may be modified as the experiment progresses in order that higher quality silicon sheet may be the input for other experiments. The equipment will be modified eventually into an automated manufacturing process.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Laser and Electron Beam Anneal of Silicon Sheets
Code No. M-16
Orig. Date
Discipline
Rev. Date
Submitted by Massachusetts Institute of Technology
NASA Hq Approval
Contact G. von Tiesenhausen Center MSFC Phone (205) 453-2789
Contact D. Smith Center MIT Phone (617) 253-2272

Objective

To test the feasibility of using lasers and electron beams to do a hard anneal on space-grown silicon sheets for the purpose of enhancing crystal properties (reducing the number of grain boundaries).

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Silicon sheets supported by edge-supports will be heated to near their melting temperature by a laser in one setup and an electron beam in another. The laser and electron beam will track back and forth across the cell and move down the cell as well. The payload specialist will vary such parameters as the thickness of the cells that are being annealed, tracking speed and energy of the beam. Annealing of the silicon sheet on top of another substrate, such as Al may also be tried.

Data Sources

"Extraterrestrial Processing and Manufacturing of Large Space Systems," Contract NAS8-32925, Space Systems Lab., MIT.

Development Status

			Time (mos.)
Planning	[ ]	New Development	
Definition Studies	[x]	Modify/Upgrade Existing Hardware	
AAFE	[ ]		
Development	[ ]	Prepare/Refurbish Existing Hardware for Flight	
Existing Hardware	[ ]		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights								1	3	3			

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg		Payload Volume	cu m	0.5
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Laser	1					
Electron Gun	1					
Edge Supports	4					

Power

Operating Power	W		Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) __________

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration: 10 days.
Orbital service interval: Best use of equipment is to anneal all samples and return them to earth for detail analysis of crystal properties. Based on that analysis, the experiment might be repeated with different parameters. Cooling systems for close thermal control may also be added.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Flywheel Energy Storage Experiment
Code No. G-9
Orig. Date
Rev. Date
Discipline
Submitted by Goddard Space Flight Center
NASA Hq Approval
Contact H. E. Evans Center GSFC Phone (301) 344-5194
Contact Center Phone

Objective

To demonstrate in an orbital environment energy storage and retrieval on a long term basis with a magnetically levitated flywheel system.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Experiment package contains two counterrotating, magnetically levitated flywheels and data acquisition system. Cryogenic operation maintained by on-board refrigerator is design goal. Storage capacity is 2 kWh.

Data Sources

Telecon, H. E. Evans.

Development Status Time (mos.)

- Planning ☐
- Definition Studies ☐
- AAFE ☐
- Development ☐
- Existing Hardware ☐

Modify/Upgrade Existing Hardware ______

Prepare/Refurbish Existing Hardware for Flight ______

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights					1								

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Code No. G-9

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	60	Payload Volume	cu m	0.25
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Flywheel Storage Unit	1	60	0.75	0.75	0.45	

Power

Operating Power	W		Operating Power Duration		hr
Peak Power	W	2000	Peak Power Duration	1	hr/charge

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	Any		
Inclination, deg	Any		

Target(s) None

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--maximum available. No service visits required.
Charging cycle would require 2000 W for one hour.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Electrochemical Mass Transfer in the Space Environment
Code No.: J-8
Orig. Date:
Discipline:
Rev. Date:
Submitted by: Jet Propulsion Laboratory
NASA Hq Approval:
Contact: A. A. Uchiyama — Center: JPL — Phone: (213) 354-4039
Contact: — Center: — Phone:

Objective

The objective of this experiment is to define the effects of convective mass transfer in selected electrochemical processes. Definition of these effects will permit the development of a refined theory of electrochemical mass transfer which will find application in power producing (battery) electrochemical processes and materials processing in the space environment.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

The flight experiment includes limiting current measurements on: (1) Copper electrodes in aqueous copper sulfate; (2) Zinc electrodes in aqueous potassium hydroxide; and (3) Lithium electrodes in a nonaqueous electrolyte. Potential differences between test and reference electrodes will be monitored as current is applied in accordance with a linear ramp. The experiment will be located in a tray not requiring exposure to the space environment and will be initiated after zero gravity is achieved. The experiment will contain power supply and data recording capability. A payload specialist will be required to initiate the experiment. It will be necessary to recover the experiment for analysis.

Data Sources

"Gravitational Effects on Electrochemical Batteries," JPL Tech. Report 32-1570, November 15, 1972.
"Performance of Alkaline Battery Cells in a Zero-Gravity Environment," R. Meredith, G. Juvinall, A. Uchiyama - Proceeding of Electrochemical Society, Annual Meeting, Las Vegas, Nevada, Oct. 1976.

Development Status

- Planning [x]
- Definition Studies [ ]
- AAFE [ ]
- Development [ ]
- Existing Hardware [ ]

	Time (mos.)
Modify/Upgrade Existing Hardware	
Prepare/Refurbish Existing Hardware for Flight	

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights					1								

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	15	Payload Volume	cu m	0.1
Landed Weight	kg	15	Pressurized Equipment	cu m	0.1
Pressurized Equipment	kg	15	Unpressurized Equipment	cu m	0
Unpressurized Equipment	kg	0	Control & Display Area	sq m	0.1

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Power Supply	1	6	0.3	0.3	0.3	TBD
Power Conditioner	1	2	0.3	0.3	0.1	TBD
Signal Conditioner	1	1	0.3	0.3	0.2	TBD
Recorder	1	5	0.3	0.3	0.2	TBD
Electrochemical Test Cells	6	1	0.3	0.3	0.3	TBD

Power

Operating Power	W	56	Operating Power Duration	8	hr/test
Peak Power	W	560	Peak Power Duration	1.4×10^{-5}	hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) NA

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Flight duration--1 mo.
Power duration is per test. There would be a number of tests on a long duration flight.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Application of Terrestrial Solar Arrays in a Space Environment
Code No.: Le-2
Orig. Date:
Discipline:
Rev. Date:
Submitted by: Lewis Research Center
NASA Hq Approval:
Contact: Julian Been Center: LeRC Phone: (216) 433-4000 X233
Contact: Center: Phone:

Objective

Space qualify commercial solar cells with "improved" interconnects.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Experiment package would consist of an approximately one square foot solar array plus supporting electronics to record typical solar cell parameters.

Data Sources

Telecon, Julian Been.

Development Status

- Planning [x]
- Definition Studies [ ]
- AAFE [ ]
- Development [ ]
- Existing Hardware [ ]

Time (mos.)

- Modify/Upgrade Existing Hardware: ______
- Prepare/Refurbish Existing Hardware for Flight: ______

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights			1										

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	3 (est.)	Payload Volume	cu m	0.01
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Solar Array Experiment			0.3	0.3	0.1	

Power

Operating Power	W	5 (est.)	Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km	LEO		
Inclination, deg			

Target(s) Sun-oriented experiment. Pointing not critical.

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--6 mo.
Contact desires flight in 1980-82 time frame. Mid-80's would be too late.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Solar Cell Verification Flight Test
Code No. Le-3
Orig. Date
Discipline
Rev. Date
Submitted by Lewis Research Center
NASA Hq Approval
Contact D. T. Bernatowicz Center LeRC Phone (216) 433-4000 X6786
Contact Center Phone

Objective

To space qualify state-of-the-art solar cell samples.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Experiment package consists of 10 to 100 (2x2 cm, 2x4 cm, or 2x6 cm) solar cells. Package also includes a data acquisition system to record typical solar cell parameters at a rate of one data run/day initial and one data run/month later.

Data Sources

Telecon, D. T. Bernatowicz.

Development Status

			Time (mos.)
Planning	[x]	Modify/Upgrade Existing Hardware	
Definition Studies	[ ]	Prepare/Refurbish Existing Hardware for Flight	
AAFE	[ ]		
Development	[ ]		
Existing Hardware	[ ]		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights													

Code No. Le-3

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	50	Payload Volume	cu m	0.01
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Solar Array Experiment			0.3	0.3	0.1	

Power

Operating Power	W	5 (est.)	Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km	LEO + GEO		
Inclination, deg			

Target(s) Sun-oriented experiment. Pointing not critical.

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--at least one year. Would like series of flight experiments. Need orbits representative of user orbits (low earth orbit and geosynch.).

E. Sensors

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Gravitational Dectector — Code No. M-1

Orig. Date

Discipline — Rev. Date

Submitted by — NASA Hq Approval

Contact Dr. E. W. Urban — Center MSFC — Phone (205) 453-5132

Contact — Center — Phone

Objective

Using liquid helium cooled experiment to demonstrate proof-of-principal of a gravitational detector.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Liquid He Dewar with electronics (100 liters of He).
Similar to cryostat for SL-2.

Data Sources

Dr. E. Urban, telecon 12-15-78.

Development Status — Time (mos.)

- Planning ☐
- Definition Studies ☐
- AAFE ☐
- Development ☐
- Existing Hardware ☐

New Development ______

Modify/Upgrade Existing Hardware ______

Prepare/Refurbish Existing Hardware for Flight ______

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights													

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	225	Payload Volume	cu m	0.785
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Cryostat	1	200	1 m x	1 m	dia.	
Electronics	1	25				

Power

Operating Power	W	<50	Operating Power Duration		hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) ____________

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--2 to 3 weeks.
Flight schedule flexible.
Would use cryostat similar to experiment 13 on SL-2.
No special altitude or inclination requirements.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Microwave Attitude Sensor — Code No. G-11
Orig. Date ______
Discipline ______ — Rev. Date ______
Submitted by ______ — NASA Hq Approval ______
Contact A. Kampinsky — Center GSFC — Phone (301) 344-6762
Contact ______ — Center ______ — Phone ______

Objective

To determine minimum signal power requirement and verify accuracy of the Microwave Attitude Sensor on a dynamic orbital platform.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Payload consists of a six-element unfilled antenna array plus signal wavefront (phasefront) analyzer. System determines orientation of array axis relative to the direction of propagation of a pilot signal from a ground-based transmitter to an accuracy of 25 μrad. An ADI operating at 6 GHz was flight proven on ATS-6 in geosynchronous orbit. Lower frequency model proposed for space platform, with at least 2 frequencies. System can be used for position location of a 1 to 5 W signal source to an accuracy of 0.8 km from geosynchronous (35,000 km) altitude.

Data Sources

Telecon, Abe Kampinsky.

Development Status

Status			Time (mos.)
Planning	[ ]	Modify/Upgrade Existing Hardware	1 yr
Definition Studies	[ ]	Prepare/Refurbish Existing Hardware for Flight	
AAFE	[ ]		
Development	[x]		
Existing Hardware	[x]		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights			1	1									

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	10	Payload Volume	cu m	0.3
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg	-	Unpressurized Equipment	cu m	
Unpressurized Equipment	kg	10	Control & Display Area	sq m	0.8

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Array Antenna	1	4	1.5	0.1	1.5	
Processor	1	1	0.3	0.3	0.3	

Power

Operating Power	W	15	Operating Power Duration	2	hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	LEO		
Inclination, deg	Sun Sync.	30	108

Target(s) Earth-based transmitters of both known and unknown position.

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	17.5
Stability	arcsec				

NOTES

Duration--several weeks minimum.

F. THERMAL/ENVIRONMENTAL CONTROL

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Advanced Thermal Control Devices Code No. G-1
Orig. Date
Discipline Space Technology - Thermal Control Rev. Date
Submitted by Goddard Space Flight Center NASA Hq Approval
Contact S. Ollendorf Center GSFC Phone (301) 344-5228
Contact Center Phone

Objective

Thermal performance verification of thermal devices such as ion drag pumps, pump assisted heat pipes and large arterial heat pipes which can carry large quantities of heat long distance and with high power density.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Experiment(s) will consist of the heat transfer device, usually one element, i.e., a heat pipe or pump, of approximately 20 m long with heat source and heat sink and instrumentation to determine performance. New elements or devices can be plugged in on a reflight or revisit basis.

Data Sources

S. Ollendorf

Development Status

			Time (mos.)
Planning	[ ]	Modify/Upgrade Existing Hardware	12
Definition Studies	[ ]		
AAFE	[ ]	Prepare/Refurbish Existing Hardware for Flight	6
Development	[x]		
Existing Hardware	[ ]		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights			x		x		x		x		x		

(New devices)

Code No. G-1

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	100	Payload Volume	cu m	5.0
Landed Weight	kg	100	Pressurized Equipment	cu m	-
Pressurized Equipment	kg	-	Unpressurized Equipment	cu m	5.0
Unpressurized Equipment	kg	100	Control & Display Area	sq m	-

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Heat Transport Device	1	50	20	0.5	0.5	
Heat Source (Htr.)	1	10	3	0.5	0.5	
Heat Sink (Radiator)	1	40	3	3.0	0.5	

Power

Operating Power	W	1200	Operating Power Duration	24	hr
Peak Power	W	2000	Peak Power Duration	8	hr

Orbit Characteristics

		Operational Orbit		
		Desired	Minimum	Maximum
Altitude,	km	Any		
Inclination,	deg	57	38	57

Target(s) Full sun exposure desired.

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--1 to 6 mo.
Experiment may be integrated with other experiments, i.e., sensors, power supplies, radiators.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Thermal Coatings
Code No.: G-2
Orig. Date:
Discipline:
Rev. Date:
Submitted by: Goddard Space Flight Center
NASA Hq Approval:
Contact: S. Ollendorf   Center: GSFC   Phone: (301) 344-5228
Contact: Center: Phone:

Objective

As thermal control coatings are developed, space qualification is the final approval and inflight tests are the most reliable. This would provide the coating development effort with an in-space test facility with a predictable schedule.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

There will be 5 trays of 12 test disks. Each test coating disk will be thermally isolated from the tray. Since the coating properties, solar absorptance/emittance ratio is measured calorimetrically, a sun oriented location is essential. A new tray will be exchanged each year allowing introduction of latest coatings while long term tests can be conducted on other trays.

Data Sources

Development Status

			Time (mos.)
Planning	☐	Modify/Upgrade Existing Hardware	12
Definition Studies	☐	Prepare/Refurbish Existing Hardware for Flight	
AAFE	☐		
Development	☐		
Existing Hardware	x		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights				x	x		x		x		x		x

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	2	Payload Volume	cu m	
Landed Weight	kg	2	Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	0.4

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	

Power

Operating Power	W	3	Operating Power Duration	1	hr
Peak Power	W	3	Peak Power Duration	1	hr

Orbit Characteristics

		Operational Orbit		
		Desired	Minimum	Maximum
Altitude,	km	35,000	400	35,000
Inclination,	deg	57	38	57

Target(s) Sun orientation.

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--5 years/tray avg. One tray 10 years maximum. Revisit once per year.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Thermal Control Systems
Code No.: G-4
Orig. Date:
Discipline: Space Technology - Thermal Control
Rev. Date:
Submitted by: Goddard Space Flight Center
NASA Hq Approval:
Contact: S. Ollendorf Center: GSFC Phone: (301) 344-5228
Contact: Center: Phone:

Objective

Thermal performance verification of systems using one or more thermal devices which can be mounted to a self contained module containing heat sources and sinks, data acquisition, and command systems.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

1 x 1 x 3 m self contained within a thermal canister, equipped with data acquisition and command system. Placed on platform, erected in bay or on free flyer which can be reflown or revisited to update new technology items (see enclosed sketch). Experiment will be preprogrammed internally for operations.

Data Sources

"A Thermal Canister Experiment for Space Shuttle," R. McIntosh, S. Ollendorf, Third Int. Heat Pipe Conference, Palo Alto, California, May 1978.

Development Status

			Time (mos.)
Planning	x	Modify/Upgrade Existing Hardware	12
Definition Studies		Prepare/Refurbish Existing Hardware for Flight	24
AAFE			
Development			
Existing Hardware			

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights			x		x		x		x		x		x

←Reflight or revisit→

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	400	Payload Volume	cu m	3.0
Landed Weight	kg	400	Pressurized Equipment	cu m	-
Pressurized Equipment	kg	-	Unpressurized Equipment	cu m	3.0
Unpressurized Equipment	kg	400	Control & Display Area	sq m	-

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Thermal Canister	1	300	3	1.0	1.0	Platform
Experiment	1	100	20	0.5	0.5	Coiled in canister

Power

Operating Power	W	200	Operating Power Duration	24	hr
Peak Power	W	400	Peak Power Duration	8	hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	Any	Any	Any
Inclination, deg	57	38	57

Target(s) One side always to sun (for absorbing thermal energy).

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--1 to 6 months. Revisit each year.
Experiment could be flown with other experiments or sensors in or out of canister providing support systems are provided, i.e., power, data acquisition, and command.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Mechanical Cooler Flight Experiment
Code No. G-6
Orig. Date
Discipline
Rev. Date
Submitted by Goddard Space Flight Center
NASA Hq Approval
Contact Dr. Allan Sherman Center GSFC Phone (301) 344-5405
Contact Center Phone

Objective

To verify the long lifetime performance of the Goddard 3-5 year lifetime Stirling cooler in space.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Experiment package is rectangular cell with 2 sq. ft. radiator mounted on top. Basically steady-state operation with no servicing required. Will periodically check stop/start characteristics of unit. This can be done via commands.

Data Sources

Telecon, A. Sherman.

Development Status

Time (mos.)

- Planning ☐
- Definition Studies ☒
- AAFE ☐
- Development ☐
- Existing Hardware ☐

Modify/Upgrade Existing Hardware ______

Prepare/Refurbish Existing Hardware for Flight ______

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights				1	→								

Code No. G-6

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	50	Payload Volume	cu m	0.03
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Refrigerator Package	1		0.5	0.15	0.15	
Radiator	1		0.4		0.4	

Power

Operating Power	W	150	Operating Power Duration	Continuous	hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics

		Operational Orbit		
		Desired	Minimum	Maximum
Altitude,	km	NC		
Inclination,	deg	NC		

Target(s) __________

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--3 to 5 years. No servicing required.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Flexible Radiator Panel Space Evaluation
Code No. JSC-2
Orig. Date
Discipline
Rev. Date
Submitted by Johnson Space Center
NASA Hq Approval
Contact B. French Center JSC Phone (713) 483-2961
Contact W. Ellis Center JSC Phone (713) 483-4941

Objective

Thermo/optical properties evaluation of nonmetallic flexible radiator fins material as well as assessing micrometeoroid effects.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Extended flat surface area instrumented to assess thermal equilibrium. Experiment will be static requiring no control during orbit operations. Payload specialists will record usual observation and quantitative data.

Data Sources

JSC

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☐	Modify/Upgrade Existing Hardware	
AAFE	☐		
Development	x	Prepare/Refurbish Existing Hardware for Flight	18
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights		1	1										

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg 160		Payload Volume	cu m	6
Landed Weight	kg 160		Pressurized Equipment	cu m	0
Pressurized Equipment	kg 0		Unpressurized Equipment	cu m	6
Unpressurized Equipment	kg 160		Control & Display Area	sq m	0.6

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Flexible radiator panel	2	150				

Power

Operating Power W 5   Operating Power Duration 1/4 hr
Peak Power W 5   Peak Power Duration 1/4 hr

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km	Any		
Inclination, deg	Any		

Target(s) None

Pointing, Stability, and Control NA

Pointing Accuracy deg ____   Stability Rate arcsec/sec ____
Total Pointing Time hr/msn ____   Field of View (half angle) deg ____
Stability arcsec ____

NOTES

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Thermal Management
Code No. JSC-6
Orig. Date
Discipline
Rev. Date
Submitted by Johnson Space Center
NASA Hq Approval
Contact B. French Center JSC Phone (713) 483-2961
Contact W. Ellis Center JSC Phone (713) 483-4941

Objective

Develop and demonstrate the technology required for overall thermal management of space platforms thus establishing the state of the art for flight hardware.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

A 100 kg weight, 1x2x3 m geometry experimental package will permit heat generation, thermal acquisition, thermal transport, heat distribution, and heat rejection. Parametric measurement of heat transfer will verify temperature control. Payload specialist will deploy, assemble, and monitor this space platform payload. Data collected will be analyzed and reported.

Data Sources

JSC

Development Status

- [ ] Planning
- [x] Definition Studies
- [ ] AAFE
- [ ] Development
- [ ] Existing Hardware

	Time (mos.)
New Development	
Modify/Upgrade Existing Hardware	8
Prepare/Refurbish Existing Hardware for Flight	32

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights				1	1	1							

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	100	Payload Volume	cu m	6
Landed Weight	kg	100	Pressurized Equipment	cu m	1.8
Pressurized Equipment	kg	18	Unpressurized Equipment	cu m	4.2
Unpressurized Equipment	kg	82	Control & Display Area	sq m	1.5

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Modular radiator	4					
Fluid loop	2					
Heat Exchanger	As Req.	As required to satisfy space platform payload requirements.				
Swivel-rotating joint	8					
Cold plates	3					
Heat pipes	30					

Power

Operating Power	W	10,000	Operating Power Duration	TBD	hr
Peak Power	W	Same	Peak Power Duration	TBD	hr

Orbit Characteristics

		Operational Orbit Desired	Minimum	Maximum
Altitude,	km	Any		
Inclination,	deg	Any		

Target(s) None

Pointing, Stability, and Control

As available.

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym Heat Pipe Radiator Panel Space Evaluation
Code No. JSC-4
Orig. Date
Rev. Date
Discipline
Submitted by Johnson Space Center
NASA Hq Approval
Contact B. French Center JSC Phone (713) 483-2961
Contact W. Ellis Center JSC Phone (713) 483-4941

Objective

Thermal degradation properties evaluation of heat pipe radiator panel.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

Extended flat surface area instrumented to measure the heat transfer through the radiator. Panel will utilize passive VCHP control. Payload specialists will record observations and thermal data as required.

Data Sources

JSC

Development Status

- Planning [ ]
- Definition Studies [ ]
- AAFE [ ]
- Development [ ]
- Existing Hardware [x]

	Time (mos.)
New Development	
Modify/Upgrade Existing Hardware	
Prepare/Refurbish Existing Hardware for Flight	6

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights		1											

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	130	Payload Volume	cu m	6
Landed Weight	kg	130	Pressurized Equipment	cu m	0.1
Pressurized Equipment	kg	30	Unpressurized Equipment	cu m	5.9
Unpressurized Equipment	kg	100	Control & Display Area	sq m	0.25

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Heat Pipe Radiator Panel	1	130				

Power

Operating Power	W	30	Operating Power Duration	Continual	hr
Peak Power	W	30	Peak Power Duration	1/4 hr/6	hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	Any		
Inclination, deg	Any		

Target(s) None

Pointing, Stability, and Control NA

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Space Constructable Long Life Heat Rejection System
Code No. JSC-5
Orig. Date
Discipline
Rev. Date
Submitted by Johnson Space Center
NASA Hq Approval
Contact B. French Center JSC Phone (713) 483-2961
Contact W. Ellis Center JSC Phone (713) 483-4941

Objective

Flight test an advanced space constructable radiator system concept applicable to large spacecraft.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

The space constructable system shall include pumped fluid loops, heat pipes, radiating surfaces and thermal control coatings. Payload specialist will erect system and monitor systems operation.

Data Sources

JSC

Development Status

- Planning ☐
- Definition Studies ☐
- AAFE ☐
- Development ☒
- Existing Hardware ☐

	Time (mos.)
New Development	
Modify/Upgrade Existing Hardware	
Prepare/Refurbish Existing Hardware for Flight	60

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights					1	1							

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry TBD

Total Launch Weight	kg	______	Payload Volume	cu m	______
Landed Weight	kg	______	Pressurized Equipment	cu m	______
Pressurized Equipment	kg	______	Unpressurized Equipment	cu m	______
Unpressurized Equipment	kg	______	Control & Display Area	sq m	______

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location in Orbiter
Fluid loops						
Heat Exchangers						
Fluid disconnects		To be specified during design of candidate space platform payloads.				
Fin fabrications						
Coating application						

Power

Operating Power	W	TBD	Operating Power Duration	TBD	hr
Peak Power	W		Peak Power Duration		hr

Orbit Characteristics *

	Operational Orbit Desired	Minimum	Maximum
Altitude			
Inclination, deg			

Target(s) None

Pointing, Stability, and Control *

Pointing Accuracy	deg	______	Stability Rate	arcsec/sec	______
Total Pointing Time	hr/msn	______	Field of View (half angle)	deg	______
Stability	arcsec	______			

NOTES

*As required for flight verification.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Two-Phase Radiator Panel Space Evaluation
Code No.: JSC-3
Orig. Date:
Discipline:
Rev. Date:
Submitted by: Johnson Space Center
NASA Hq Approval:
Contact: B. French — Center: JSC — Phone: (713) 483-2961
Contact: W. Ellis — Center: JSC — Phone: (713) 483-4941

Objective

Dynamic flight test of fluid loop and refrigeration radiating panel. Specific evaluation and life testing of critical components required to support space-flight heat rejection.

Description (Physical package, experiment activities, on-orbit operations, control, use of payload specialist, etc.)

High density payload package, deployed to a large radiator surface and small volume control package. Payload specialist will deploy and make operational in space and then control and monitor experiment.

Data Sources

JSC

Development Status

			Time (mos.)
Planning	☐	New Development	
Definition Studies	☒	Modify/Upgrade Existing Hardware	
AAFE	☒	Prepare/Refurbish Existing Hardware for Flight	
Development	☐		
Existing Hardware	☐		

Flight Schedule (Circle no. if approved for flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights				1	1								

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry *

Total Launch Weight	kg	______	Payload Volume	cu m	______
Landed Weight	kg	______	Pressurized Equipment	cu m	______
Pressurized Equipment	kg	______	Unpressurized Equipment	cu m	______
Unpressurized Equipment	kg	______	Control & Display Area	sq m	______

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Compressor						
Pump						
Radiator Panel						
Plumbing						
Control Valves						
Heat Exchanger						
Accumulator						

Power *

Operating Power	W	______	Operating Power Duration	______	hr
Peak Power	W	______	Peak Power Duration	______	hr

Orbit Characteristics

None required.

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km			
Inclination, deg			

Target(s) None

Pointing, Stability, and Control

NA

Pointing Accuracy	deg	______	Stability Rate	arcsec/sec	______
Total Pointing Time	hr/msn	______	Field of View (half angle)	deg	______
Stability	arcsec	______			

NOTES

*Designed to support space platform payload.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Deployment and Performance of Large Space Shield
Code No. J-2
Orig. Date
Discipline
Rev. Date
Submitted by Jet Propulsion Laboratory
NASA Hq Approval
Contact W. H. Steurer **Center** **Phone** (213) 354-5404
Contact **Center** **Phone**

Objective

To demonstrate the effectiveness of large space shields for the protection of science experiments, sensitive operational systems, or erection activities against detrimental space environments, such as sunlight ("shadow shields"), UV radiation, charged particles or meteoroid bombardment. The specific objective of the experiment is to verify the performance of the selected design, the method of deployment and the effectiveness of the shielding materials.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

The shield consists of a curtain (curtains) of coated thin film (opaque polymer), supported and deployed by an ultralightweight structure. Configuration as deployed: planar-polygonal, adapted to present platform designs (LaRC/Rockwell; JSC/MDAC). Shield package is attached to fully erected and berthed platform via RMS. Sensors are integrated in selected science experiment units or platform pallets at strategic locations. Self-deployment of or retraction of the shield at operational platform altitude is initiated by single command signals. Data transmission rate approximately 100 bps.

Data Sources

Development Status

			Time (mos.)
Planning	[x]	Modify/Upgrade Existing Hardware	
Definition Studies	[ ]	Prepare/Refurbish Existing Hardware for Flight	
AAFE	[ ]		
Development	[ ]		
Existing Hardware	[ ]		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights					1								

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	44.8	Payload Volume	cu m	3.2
Landed Weight	kg	33.0	Pressurized Equipment	cu m	0.1
Pressurized Equipment	kg	3.2	Unpressurized Equipment	cu m	3.1
Unpressurized Equipment	kg	41.6	Control & Display Area	sq m	1.2

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	
Payload Canister	1	36.0	6.0	0.7	0.7	Pallet
Pallet Attach. Structure	4	1.2 ea	1.0	0.2	0.2	Pallet
Control/Display Box	1	2.4	0.6	0.4	0.2	Module
Wiring/Switches	-	1.6	-	-	-	TBD

Power

Operating Power	W	50	Operating Power Duration	300	hr
Peak Power	W	800	Peak Power Duration	0.8	hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	500	300	>500
Inclination, deg		Any	

Target(s) ________

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--6 mo.-1 yr.
Location of pallet hardware not critical. Determined by location of (or interference with) other payloads.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym: Large Radiator Systems
Code No.: G-5
Orig. Date:
Discipline: Space Technology - Thermal Control
Rev. Date:
Submitted by: Goddard Space Flight Center
NASA Hq Approval:
Contact: S. Ollendorf Center: GSFC Phone: (301) 344-5228
Contact: Center: Phone:

Objective

(1) Quantify radiator requirements for future space missions. (2) Identify heat pipe or other design concepts suitable for heat transport capacity for large systems. (3) Determine Spacelab and assembly techniques and demonstrate in orbit.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

Phase 1 - Single radiator element (1x1 m).
Phase 2 - Multiple units (2 or 3), assembled or manufactured in space.
Phase 3 - Full array (10x10 m)
Phase 4 - Revisited to determine performance degradation and refit with new technology items. Requires data acquisition system and power supply (can be integrated with other experiments or systems for these services).

Data Sources

S. Ollendorf

Development Status

			Time (mos.)
Planning	[x]	Modify/Upgrade Existing Hardware	NA
Definition Studies	[ ]	Prepare/Refurbish Existing Hardware for Flight	12, Phase 1, 2 24, Phase 3, 4
AAFE	[ ]		
Development	[ ]		
Existing Hardware	[ ]		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights			x	x		x		x		x		x	
			P1	P2		P3		P4		P4		P4	

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg 5*	Payload Volume	cu m 0.25
Landed Weight	kg 5	Pressurized Equipment	cu m -
Pressurized Equipment	kg -	Unpressurized Equipment	cu m 0.25
Unpressurized Equipment	kg 5	Control & Display Area	sq m -

*Each radiator module.

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M) L	W	H	Location
Radiator Module	100**	500	1.0	1.0	0.25	
Power Supply (Battery)	1	100	1.0	1.0	0.5	
Data Acquisition System	1	25	0.5	0.5	0.5	
**Phase dependent.						

Power

Operating Power W 1000
Peak Power W 3000
Operating Power Duration 24 hr/mo.
Peak Power Duration 8 hr/mo.

Orbit Characteristics

	Operational Orbit Desired	Minimum	Maximum
Altitude, km	Any		
Inclination, deg	57	38	57

Target(s) NA

Pointing, Stability, and Control

Pointing Accuracy deg ______
Total Pointing Time hr/msn ______
Stability arcsec ______
Stability Rate arcsec/sec ______
Field of View (half angle) deg ______

NOTES

Duration--1 to 6 months. Revisit each year.
This experiment may be integrated with other experiments, i.e., sensors, power modules.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY
INVESTIGATION/INSTRUMENT/FACILITY PLANNING DATA
SUMMARY

1-GENERAL INFORMATION

Name/Acronym Contamination Control Code No. G-3
Orig. Date
Discipline Rev. Date
Submitted by Goddard Space Flight Center NASA Hq Approval
Contact S. Ollendorf Center GSFC Phone (301) 344-5228
Contact Center Phone

Objective

To correlate inflight data for the effects of contamination on thermal control coatings with an analytical mass transport model supported by simulated space test of controlled contaminated thermal control coatings.

Description (Physical Package, Experiment Activities, On Orbit Operations, Control, Use of Payload Specialist, etc.)

A Quartz Crystal Microbalance (QCM) + 3 thermally isolated control samples thermally monitored and temperature controlled are mounted in a self-contained package. Several packages can be located on a platform to measure the dependence of contamination on platform location with respect to vents, thrusters, suspected outgasses.

Self-contained 1216 Å reflectance monitor located near one of the above packages.

Data Sources

S. Ollendorf

Development Status

			Time (mos.)
Planning	☐	Modify/Upgrade Existing Hardware	12
Definition Studies	☐	Prepare/Refurbish Existing Hardware for Flight	
AAFE	☐		
Development	☒		
Existing Hardware	☒		

Flight Schedule (Circle No. If Approved for Flight)

CY	79	80	81	82	83	84	85	86	87	88	89	90	91
No. of Flights				x		x		x		x		x	x

3-PHYSICAL/OPERATIONAL REQUIREMENTS

Mass and Geometry

Total Launch Weight	kg	2	Payload Volume	cu m	
Landed Weight	kg		Pressurized Equipment	cu m	
Pressurized Equipment	kg		Unpressurized Equipment	cu m	
Unpressurized Equipment	kg		Control & Display Area	sq m	0.2

Major Mission Equipment

Identification/Function	Qty	Wt (kg)	Dimension (M)			Location
			L	W	H	

Power

Operating Power	W	5	Operating Power Duration	24	hr
Peak Power	W	10	Peak Power Duration	1	hr

Orbit Characteristics

	Operational Orbit		
	Desired	Minimum	Maximum
Altitude, km	35,000	400	35,000
Inclination, deg	57	38	57

Target(s)

Pointing, Stability, and Control

Pointing Accuracy	deg		Stability Rate	arcsec/sec	
Total Pointing Time	hr/msn		Field of View (half angle)	deg	
Stability	arcsec				

NOTES

Duration--5 years. Revisit each 6 months.
Sensing will include exchange packages and/or changing locations, exchanging reflectometer mirrors.

III. PAYLOAD REQUIREMENTS SUMMARIZATION

The major data items on each payload are summarized in two tables presented here. The data are presented exactly as provided by the payload contacts and missing items are indicated by TBD. The payloads are grouped by technology in the first table and by orbital requirements in the second table. The technology grouping parallels the arrangement of the data sheets. The grouping by orbital requirements is included for the benefit of mission planning personnel and contains three major categories: Zero-G, Pointing, and Space Environment. The Pointing group has earth pointing and inertial pointing subcategories, and the Space Environment group is divided into a low orbit and a high orbit category.

The data tables are followed by two schedules which show the approximate launch date and flight duration for each payload as requested by the payload contact. Several points should be stated regarding these schedules. First of all, the schedules start with 1983 and those payloads for which an earlier first flight date is requested are assigned a 1983 launch date for the purpose of this study. Secondly, the schedules show hardware delivery and retrieval flights only and do not attempt to show any revisits for servicing or inspection which may be desired by experimenters. Also, flight duration information was not provided for some payloads. In these cases an appropriate flight duration was estimated based on the description and objective of on-orbit activities. Finally, numerous flights of short duration are indicated for several of the materials processing payloads. Some of these flights represent a repetition of the same experiment and others represent the sequential testing of elements of a more complex system. Clearly the potential exists for consolidating flights by leaving hardware in space between experiments. However, most of these payload concepts are in an early state of definition, and no effort was made here to evaluate their potential for flight consolidation.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS

COMMUNICATIONS

IDENTIFICATION	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	OTHER
Self-Tracking Antenna Experiments	45	30	20, TBD	850, 108	Earth	Sun synchronous polar orbit.
ESSA Communication Subsystem	100	10	33, TBD	any, any	TDRSS	
Fiber Optic Multiplexer for Inter-Computer Communication	25	2	100, 84	TBD, TBD	Radiation	
Large Deployable Antenna With Electronic Beam Steering	1179	200	200, 24	any, any	TBD	

MATERIALS (LONG TERM EFFECT UPON)

IDENTIFICATION	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	OTHER
Long Term Space Environment Effects on Materials	70	10	100, TBD	TBD, any	Sun	Full exposure to sun required.
Long Term Radiation Exposure of Materials	560	100	10, TBD	1000, 45	Radiation belts	Exposure to outer Van Allen Belts desired.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIATE SPACE PLATFORM PAYLOADS

MATERIALS TECHNOLOGY DEVELOPMENT

IDENTIFICATION	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	OPERATIONAL ALTITUDE (km) INCLINATION (deg)	TARGET/ EXPOSURE	OTHER
Continuous Casting of Billets and Slabs	200	70	TBD, TBD	any, any	None	
Space Welding and Cutting Techniques Laboratory	TBD	TBD	TBD, TBD	any, any	None	
Casting of Complex Parts	200	70	TBD, TBD	any, any	None	
Rotating Furnace for Glass Production	500	40	TBD, 3	any, any	None	
Direct Vaporization of Silicon Sheet	TBD	20	TBD, TBD	any, any	None	
Direct Vaporization of Aluminum Through Shadow Masks and Subsequent Mask Cleanup	TBD	20	TBD, TBD	any, any	None	
Direct Vaporization of Silica Glass Onto Space-Grown Silicon Sheets With Aluminum Contacts	TBD	20	TBD, TBD	any, any	None	
Glass Foaming	TBD	40	TBD, 16/cycle	any, any	None	
Wire Drawing and Glass Fiber Extrusion	TBD	20	TBD, TBD	any, any	None	
Chemical Vapor Deposition of Silicon Sheet	TBD	20	TBD, TBD	any, any	None	
Laser and Electron Beam Anneal of Silicon Sheets	TBD	20	TBD, TBD	any, any	None	

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS

POWER

IDENTIFICATION	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	OTHER
Flywheel Energy Storage Experiment	60	5	2000, 1/charge	any, any	None	
Electrochemical Mass Transfer in the Space Environment	15	5	56, 8/test	any, any	None	Several tests/mission.
Application of Terrestrial Solar Arrays in a Space Environment	3	1	5, TBD	LEO, any	Sun	Require 80-82 flight date.
Solar Cell Verification Flight Test	50	5	5, TBD	LEO/GEO, any	Sun	

SENSORS

IDENTIFICATION	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	OTHER
Gravitational Detector	225	10	<50, TBD	any, any	Low-g	
Microwave Attitude Sensor	10	15	15, TBD	850, 108	Earth	Sun synchronous polar orbit.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST) CANDIDATE SPACE PLATFORM PAYLOADS

THERMAL/ENVIRONMENTAL CONTROL

IDENTIFICATION	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	OTHER
Advanced Thermal Control Devices	100	65	1200, 24	any, 57	None	Full sun exposure desired.
Thermal Coatings	2	10	3, 1	35000, 57	Sun	
Thermal Control Systems	400	25	200, 24	any, 57	Sun	One side to sun always.
Mechanical Cooler Flight Experiment	50	5	150, cont.	any, any	None	
Flexible Radiator Panel Space Evaluation	160	50	5, TBD	any, any	None	
Thermal Management	100	50	10000, TBD	any, any	None	
Heat Pipe Radiator Panel Space Evaluation	130	50	30, cont.	any, any	None	
Space Constructable Long Life Heat Rejection System	TBD	TBD	TBD, TBD	TBD, TBD	None	
Two-Phase Radiator Panel Space Evaluation	TBD	TBD	TBD, TBD	any, any	None	
Deployment and Performance of Large Space Shield	45	50	50, 300	500, any	None	
Large Radiator Systems	625	25	1000, 24/mo	any, 57	None	Full sun exposure desired.
Contamination Control	2	1	5, 24	35000, 57	None	

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIATE SPACE PLATFORM PAYLOADS

IDENTIFICATION	CENTER	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	INITIAL LAUNCH DATE
ZERO-G					
Gravitational Detector	MSFC	225	10	<50, TBD	TBD
POINTING (EARTH, LEO)					
Large Deployable Antenna With Electronic Beam Steering	JPL	1179	200	200, 24	1984
POINTING (EARTH, SUN SYNCHRONOUS)					
Self-Tracking Antenna Experiments	GSFC	45	30	20, TBD	1983[1]
Microwave Attitude Sensor	GSFC	10	15	15, TBD	1983[1]
POINTING (SPACE)					
ESSA Communication Subsystem	GSFC	100	10	33, TBD	1983[1]

1 Earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS

IDENTIFICATION	CENTER	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	INITIAL LAUNCH DATE
POINTING (SOLAR)					
Application of Terrestrial Solar Arrays in a Space Environment	LeRC	3	1	5, TBD	1983[1]
Solar Cell Verification Flight Test	LeRC	50	5	5, TBD	1983
Long Term Space Environment Effects on Materials	MSFC	70	10	100, TBD	1983[1]
Advanced Thermal Control Devices	GSFC	100	65	1200, 24	1983[1]
Thermal Coatings	GSFC	2	10	3, 1	1983[1]
Thermal Control Systems	GSFC	400	25	200, 24	1983[1]
SPACE ENVIRONMENT (HEO)					
Fiber Optic Multiplexer for Inter-Computer Communication	JSC	25	2	100, 84	1983
Contamination Control	GSFC	2	1	5, 24	1983[1]
Long Term Radiation Exposure of Materials	LaRC	560	100	10, TBD	1983
Deployment and Performance of Large Space Shield	JPL	45	50	50, 300	1983
Large Radiator Systems	GSFC	625	25	1000, 24/mo	1983[1]

1 Earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS

SPACE ENVIRONMENT (LEO)

IDENTIFICATION	CENTER	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	INITIAL LAUNCH DATE
Flexible Radiator Panel Space Evaluation	JSC	160	50	5, TBD	1983[1]
Thermal Management	JSC	100	50	10000, TBD	1983[1]
Heat Pipe Radiator Panel Space Evaluation	JSC	130	50	30, cont.	1983[1]
Space Constructable Long Life Heat Rejection System	JSC	TBD	TBD	TBD, TBD	1983
Two-Phase Radiator Panel Space Evaluation	JSC	TBD	TBD	TBD, TBD	1983[1]
Electrochemical Mass Transfer in the Space Environment	JPL	15	5	56, 8/test	1983
Mechanical Cooler Flight Experiment	GSFC	50	5	150, cont.	1983[1]
Flywheel Energy Storage Experiment	GSFC	60	5	2000, 1/charge	1983
Continuous Casting of Billets and Slabs	MSFC	200	70	TBD, TBD	1983[1]
Space Welding and Cutting Techniques Laboratory	MSFC	TBD	TBD	TBD, TBD	1983[1]

1 Earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS

SPACE ENVIRONMENT (LEO CONCLUDED)

IDENTIFICATION	CENTER	PAYLOAD WEIGHT (kg)	PALLET AREA (%)	POWER FROM PLATFORM (W), DURATION (hr)	INITIAL LAUNCH DATE
Casting of Complex Parts	MSFC	200	70	TBD, TBD	1985
Rotating Furnace for Glass Production	MSFC	500	40	TBD, 3	1985
Direct Vaporization of Silicon Sheet	MSFC	TBD	20	TBD, TBD	1985
Direct Vaporization of Aluminum Through Shadow Masks and Subsequent Mask Cleanup	MSFC	TBD	20	TBD, TBD	1985
Direct Vaporization of Silica Glass Onto Space-Grown Silicon Sheets With Aluminum Contacts	MSFC	TBD	20	TBD, TBD	1985
Glass Foaming	MSFC	TBD	40	TBD, 16 cyc	1986
Wire Drawing and Glass Fiber Extrusion	MSFC	TBD	20	TBD, TBD	1986
Chemical Vapor Deposition of Silicon Sheet	MSFC	TBD	20	TBD, TBD	1986
Laser and Electron Beam Anneal of Silicon Sheets	MSFC	TBD	20	TBD, TBD	1986

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY 1983	1984	1985	1986	1987	1988	1989	1990	MISSION DURATION
COMMUNICATIONS									
Self-Tracking Antenna Experiments	(X) ▼								6 mos[1]
ESSA Communication Subsystem	(X)								10 yrs
Fiber Optic Multiplexer for Inter-Computer Communication	X ▼								1-6 mos[1]
Large Deployable Antenna With Eléctronic Beam Steering			X ▼						1 mo - 1 yr
MATERIALS (LONG TERM EFFECT UPON)									
Long Term Space Environment Effects on Materials	(X)		▼						1-2 yrs
Long Term Radiation Exposure of Materials	X			▼					2-3 yrs[1]

1 Independent estimate. Data item not available from payload contact.

(X) Signifies earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY 1983	1984	1985	1986	1987	1988	1989	1990	MISSION DURATION
MATERIALS TECHNOLOGY DEVELOPMENT									
Continuous Casting of Billets and Slabs	X▼ X▼ X▼	X▼ X▼ X▼		X▼ X▼	X▼ X▼				10 days
Space Welding and Cutting Techniques Laboratory	Ⓧ▼ X▼ X▼	X▼ X▼ X▼							10 days
Casting of Complex Parts			X▼ X▼ X▼	X▼ X▼ X▼	X▼ X▼ X▼				20 days
Rotating Furnace for Glass Production			X▼ X▼ X▼	X▼ X▼ X▼	X▼ X▼ X▼				40 days
Direct Vaporization of Silicon Sheet			X▼	X▼ X▼	X▼ X▼ X▼				20 days
Direct Vaporization of Aluminum Through Shadow Masks and Subsequent Mask Cleanup			X▼	X▼ X▼	X▼ X▼ X▼				20 days
Direct Vaporization of Silica Glass Onto Space-Grown Silicon Sheets With Aluminum Contacts			X▼	X▼ X▼	X▼ X▼ X▼				20 days
Glass Foaming				X▼ X▼ X▼	X▼ X▼ X▼ X▼	X▼ X▼ X▼ X▼			70 days
Wire Drawing and Glass Fiber Extrusion				X▼ X▼ X▼	X▼ X▼ X▼				20 days
Chemical Vapor Deposition of Silicon Sheet				X▼ X▼	X▼ X▼ X▼	X▼ X▼ X▼ X▼			20 days
Laser and Electron Beam Anneal of Silicon Sheets				X▼	X▼ X▼ X▼	X▼ X▼ X▼ X▼			10 days

Ⓧ Signifies earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY 1983	1984	1985	1986	1987	1988	1989	1990	MISSION DURATION
POWER									
Flywheel Energy Storage Experiment	X								10 days
Electrochemical Mass Transfer in the Space Environment	X								30 days
Application of Terrestrial Solar Arrays in a Space Environment	(X)								6 mos
Solar Cell Verification Flight Test	X								1-5 yrs
SENSORS									
Gravitational Detector	X								2-3 wks
Microwave Attitude Sensor	(X)								30 days

(X) Signifies earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY 1983	1984	1985	1986	1987	1988	1989	1990	MISSION DURATION
THERMAL/ENVIRONMENTAL CONTROL									
Advanced Thermal Control Devices	(X) ▼		X ▼		X ▼		X ▼		1-6 mos
Thermal Coatings	(X)								10 yrs
Thermal Control Systems	(X) ▼		X ▼		X ▼		X ▼		1-6 mos
Mechanical Cooler Flight Experiment	(X)					▼			3-5 yrs
Flexible Radiator Panel Space Evaluation	(X)					▼			3-5 yrs[1]
Thermal Management	(X) ▼								1-6 mos[1]
Heat Pipe Radiator Panel Space Evaluation	(X)			▼					3 yrs[1]
Space Constructable Long Life Heat Rejection System	X			▼					3 yrs[1]
Two-Phase Radiator Panel Space Evaluation	(X)			▼					3 yrs[1]
Deployment and Performance of Large Space Shield	X	▼							6 mos - 1 yr
Large Radiator Systems		(X) ▼		X ▼		X ▼		X ▼	1-6 mos
Contamination Control		(X)					▼		5 yrs

1 Independent estimate. Data item not available from payload contact.

(X) Signifies earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY 1983	1984	1985	1986	1987	1988	1989	1990	MISSION DURATION
ZERO-G									
Gravitational Detector	X								2-3 wks
POINTING (EARTH, LEO)									
Large Deployable Antenna With Electronic Beam Steering			X						1 mo - 1 yr
POINTING (EARTH, SUN SYNCHRONOUS)									
Self-Tracking Antenna Experiments	(X)								6 mos[1]
Microwave Attitude Sensor	(X)								30 days
POINTING (SPACE)									
ESSA Communications Subsystem	(X)								10 yrs

[1] Independent estimate. Data item not available from payload contact.

(X) Signifies earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY 1983	1984	1985	1986	1987	1988	1989	1990	MISSION DURATION
POINTING (SOLAR)									
Application of Terrestrial Solar Arrays in a Space Environment	(X) ▼								6 mos
Solar Cell Verification Flight Test	X					▼			1-5 yrs
Long Term Space Environment Effects on Materials	(X)		▼						1-2 yrs
Advanced Thermal Control Devices	(X) ▼		X ▼		X ▼		X ▼		1-6 mos
Thermal Coatings	(X)								10 yrs
Thermal Control Systems	(X) ▼								1-6 mos
SPACE ENVIRONMENT (HEO)									
Fiber Optic Multiplexer for Inter-Computer Communication	X ▼								1-6 mos[1]
Contamination Control		(X)					▼		5 yrs
Long Term Radiation Exposure of Materials	X			▼					2-3 yrs[1]
Deployment and Performance of Large Space Shield	X	▼							6 mos - 1 yr
Large Radiator Systems		(X) ▼		X ▼		X ▼		X ▼	1-6 mos

1 Independent estimate. Data item not available from payload contact.

(X) Signifies earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY 1983	1984	1985	1986	1987	1988	1989	1990	MISSION DURATION
SPACE ENVIRONMENT (LEO)									
Flexible Radiator Panel Space Evaluation									3-5 yrs[1]
Thermal Management									1-6 mos[1]
Heat Pipe Radiator Panel Space Evaluation									3 yrs[1]
Space Constructable Long Life Heat Rejection System									3 yrs[1]
Two-Phase Radiator Panel Space Evaluation									3 yrs[1]
Electrochemical Mass Transfer in the Space Environment									30 days
Mechanical Cooler Flight Experiment									3-5 yrs
Flywheel Energy Storage Experiment									10 yrs
Continuous Casting of Billets and Slabs									10 days
Space Welding and Cutting Techniques Laboratory									10 days

1 Independent estimate. Data item not available from payload contact.

(X) Signifies earlier first flight date requested by payload contact.

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST)
CANDIDATE SPACE PLATFORM PAYLOADS
FLIGHT SCHEDULE

PAYLOAD	CY								MISSION DURATION
	1983	1984	1985	1986	1987	1988	1989	1990	
SPACE ENVIRONMENT (LEO CONCLUDED)									
Casting of Complex Parts			x▼x▼x▼	x▼x▼x▼	x▼x▼x▼				20 days
Rotating Furnace for Glass Production			x▼x▼x▼	x▼x▼x▼	x▼x▼x▼				40 days
Direct Vaporization of Silicon Sheet			x▼	x▼x▼	x▼x▼x▼				20 days
Direct Vaporization of Aluminum Through Shadow Masks and Subsequent Mask Cleanup			x▼	x▼x▼	x▼x▼x▼				20 days
Direct Vaporization Silica Glass Onto Space-Grown Silicon Sheets With Aluminum Contacts			x▼	x▼x▼	x▼x▼x▼				20 days
Glass Foaming				x▼x▼x▼	x▼x▼x▼x▼	x▼x▼x▼x▼			70 days
Wire Drawing and Glass Fiber Extrusion				x▼x▼x▼	x▼x▼x▼				20 days
Chemical Vapor Deposition of Silicon Sheet				x▼x▼	x▼x▼x▼	x▼x▼x▼x▼			20 days
Laser and Electron Beam Anneal of Silicon Sheets				x▼	x▼x▼x▼	x▼x▼x▼			10 days

IV. PALLET-LEVEL REQUIREMENTS SUMMARIZATION

To aid in the definition of carrier-level mission requirements the payloads in the payload model were grouped into flight-compatible, pallet-size groups. The organization of payloads into groups is presented in Table I. The grouping process began with the identification of full-pallet payloads. Of the remaining payloads those with a major driver such as target/ exposure requirement or orbit/inclination requirement were identified and grouped by launch year and flight duration. These groups were filled in with non-critical payloads to round out each pallet complement. The groups were then examined and selected payloads were reshuffled to improve compatibility and or pallet occupancy.

Two comments should be made regarding Table I. First of all, to minimize the number of undefined characteristics certain data items were estimated where they were not supplied by the payload contact. These estimates were based on the description of the subject payload and on a comparison with payloads of similar nature. The estimated items are so identified. Secondly, the pallet area percentages refer to the stowed configuration in all cases where a payload is deployable.

The major data items on each payload group are summarized in Table II. It should be noted that all or part of some data items represent an estimate. These items are so identified. Also, the power numbers represent the straight sum of the values for the individual payloads since operating timelines or duty cycles were not addressed in this study.

A flight schedule for each payload group is presented in Figure 1. As was mentioned with regard to the flight schedules of certain materials processing payloads some potential exists for the consolidation of flights by leaving hardware in space between experiments. However, the mission durations indicated here are based on the requests of the payload contacts, and no effort has been made here to evaluate the potential for flight consolidation. It should also be mentioned that these indicated launches represent hardware delivery flights and not service flights. The requirement for service flights was not directly addressed in this study.

TABLE I. OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST) PAYLOAD GROUPS (SHEET 1 OF 4)

PAYLOAD IDENTIFICATION	PALLET AREA (%)	PAYLOAD WEIGHT (kg)	POWER (W)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	LAUNCH DATE, FLIGHT DURATION
GROUP A--METALS TECHNOLOGY I						
Continuous Casting of Billets and Slabs	70	200	250[2]	any, any	-	1983, 10 days
Furnace and Source Metal for Casting Facility	30	800	750			
GROUP B--SPACE EFFECTS ON MATERIALS I						
Long Term Space Environment Effects on Materials	10	70	100	TBD, any	Sun	1983[1], 1-2 yrs
Application of Terrestrial Solar Arrays in a Space Environment	1	3	5	LEO, any	Sun	1983[1], 6 mos
Flexible Radiator Panel Space Evaluation	50	160	5	any, any	-	1983[1], 3-5 yrs[2]
Solar Cell Verification Flight Test	5	50	5	LEO/GEO, any	Sun	1983, 1-5 yrs
Thermal Coatings	10	2	3	35000, 57	Sun	1983[1], 10 yrs
Contamination Control	1	2	5	35000, 57	-	1983[1], 10 yrs
ESSA Communication Subsystem	10	100	33	any, any	TDRSS	1983[1], 10 yrs
Flywheel Energy Storage Subsystem	5	60	2000	any, any	-	1983, 10 yrs
Mechanical Cooler Flight Experiment	5	50	150	any, any	-	1983, 3-5 yrs
GROUP C--SPACE EFFECTS ON MATERIALS II						
Long Term Radiation Exposure of Materials	100	560	10	1000, 45	Radiation belts	1983, 2-3 yrs

1 Earlier first flight date requested by payload contact.

2 Independent estimate. Data item not available from payload contact.

TABLE I. OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST) PAYLOAD GROUPS (SHEET 2 OF 4)

PAYLOAD IDENTIFICATION	PALLET AREA (%)	PAYLOAD WEIGHT (kg)	POWER (W)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	LAUNCH DATE, FLIGHT DURATION
GROUP D--ZERO-G						
Gravitational Detector	10	225	<50	any, any	Zero-G	1983[2], 2-3 wks
Electrochemical Mass Transfer in the Space Environment	5	15	56	LEO, any	-	1983, 1 mo
Fiber Optic Multiplexer for Inter-Computer Communications	2	25	100	TBD, any	Radiation	1983, 1-6 mos[2]
Microwave Attitude Sensor	15	10	15	850, 108	Earth	1983[1], 30 days
Self-Tracking Antenna Experiments	30	45	20	850, 108	Earth	1983[1], 6 mos[2]
GROUP E--THERMAL CONTROL I						
Thermal Management	50	100	10000	any, any	-	1983[1], 1-6 mos[2]
Thermal Control Systems	25	400	200	any, 57	Sun	1983[1], 1-6 mos
GROUP F--LARGE SPACE SHIELD						
Deployment and Performance of Large Space Shield	50	45	50	500, any	-	1983, 6 mo - 1 yr
GROUP G--WELDING AND CUTTING LABORATORY						
Space Welding and Cutting Techniques Laboratory	33	100[2]	4000[2]	any, any	-	1983[1], 10 days

1 Earlier first flight date requested by payload contact.

2 Independent estimate. Data item not available from payload contact.

TABLE I. OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST) PAYLOAD GROUPS (SHEET 3 OF 4)

PAYLOAD IDENTIFICATION	PALLET AREA (%)	PAYLOAD WEIGHT (kg)	POWER (W)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	LAUNCH DATE, FLIGHT DURATION
GROUP H--THERMAL CONTROL II						
Two Phase Radiator Panel Space Evaluation	50[2]	300[2]	500[2]	any, any	-	1983[1], 3 yrs[2]
Heat Pipe Radiator Panel Space Evaluation	50	130	30	any, any	-	1983[1], 3 yrs[2]
GROUP I--THERMAL CONTROL III						
Space Constructable Long Life Heat Rejection System	50[2]	TBD	TBD	TBD, TBD	-	1983, 3 yrs[2]
GROUP J--LARGE DEPLOYABLE ANTENNA						
Large Deployable Antenna With Electronic Beam Steering	200	1179	200	any, any	Earth	1985, 1 mo - 1 yr
GROUP K--THERMAL CONTROL IV						
Advanced Thermal Control Devices	65	100	1200	any, 57	Sun	1983[1], 1-6 mos
Large Radiator Systems	25	625	1000	any, 57	-	1983[1], 1-6 mos
GROUP L--METALS TECHNOLOGY II						
Casting of Complex Parts	70	200	250[2]	any, any	-	1985, 20 days
Furnace and Source Metal for Casting Facility	30	800	750			

1 Earlier first flight date requested by payload contact.

2 Independent estimate. Data item not available from payload contact.

TABLE I. OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST) PAYLOAD GROUPS (SHEET 4 OF 4)

GROUP M--SOLAR CELL PRODUCTION LABORATORY

PAYLOAD IDENTIFICATION	PALLET AREA (%)	PAYLOAD WEIGHT (kg)	POWER (W)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	LAUNCH DATE, FLIGHT DURATION
Chemical Vapor Deposition of Silicon Sheet	20	TBD	TBD	any, any	-	1986, 20 days
Direct Vaporization of Silicon Sheet	20[2]	TBD	TBD	any, any	-	1985, 20 days
Laser and Electron Beam Anneal Silicon Sheets	20[2]	TBD	TBD	any, any	-	1986, 10 days
Direct Vaporization of Aluminum Through Shadow Masks and Subsequent Mask Cleanup	20	TBD	TBD	any, any	-	1985, 20 days
Direct Vaporization of Silica Glass Onto Space-Grown Silicon Sheets With Aluminum Contacts	20	TBD	TBD	any, any	-	1985, 20 days

GROUP N--GLASS PROCESSING FACILITY

PAYLOAD IDENTIFICATION	PALLET AREA (%)	PAYLOAD WEIGHT (kg)	POWER (W)	OPERATIONAL ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	LAUNCH DATE, FLIGHT DURATION
Rotating Furnace for Glass Production	40	500	TBD	any, any	-	1985, 40 days
Glass Foaming	40	TBD	TBD	any, any	-	1986, 70 days
Wire Drawing and Glass Fiber Extrusion	20	TBD	TBD	any, any	-	1986, 20 days

1 Earlier first flight date requested by payload contact.

2 Independent estimate. Data item not available from payload contact.

TABLE II. OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY (OAST) PAYLOAD GROUP SUMMARY

GROUP IDENTIFICATION	PALLET OCCUPANCY (%)	PAYLOAD WEIGHT (kg)	TOTAL POWER (W)	SUGGESTED ALTITUDE (km), INCLINATION (deg)	TARGET/ EXPOSURE	SUGGESTED LAUNCH DATE, FLIGHT DURATION
Metals Technology I	100	1000	1000[1]	LEO, any	-	1983, 10 days
Space Effects on Materials I	100	497	2300	LEO, any	Sun, TDRSS	1983, 10 yrs
Space Effects on Materials II	100	560	10	1000, 45	Radiation belts	1983, 3 yrs
Zero-G	65	320	240	Sun Synch.	Earth	1983, 6 mos
Thermal Control I	75	500	10200	LEO, any	Sun	1983, 6 mos
Large Space Shield	100	45	50	LEO, any	-	1983, 1 yr
Welding and Cutting Laboratory	33	100[1]	4000[1]	LEO, any	-	1983, 10 days
Thermal Control II	100	430[1]	530[1]	LEO, any	-	1983, 3 yrs
Thermal Control III	50[1]	TBD	TBD	TBD, TBD		1983, 3 yrs
Large Deployable Antenna	200	1179	200	LEO, any	Earth	1984, 1 yr
Thermal Control IV	90	725	2200	LEO, any	Sun	1984, 6 mos
Metals Technology II	100	1000	1000[1]	LEO, any	-	1985, 20 days
Solar Cell Production Laboratory	100	TBD	TBD	LEO, any	-	1985, 20 days
Glass Processing Facility	100	TBD	TBD	LEO, any	-	1986, 70 days

1 All or part of data item represents independent estimate.

FIGURE 1. FLIGHT SCHEDULE FOR OAST SPACE PLATFORM PAYLOAD GROUPS